

burst, but heavy local rains were reported at surrounding stations.

In this connection I wish to advise you that the streams of this immediate vicinity are now in an abnormal state in consequence of the heavy rain which occurred here on August 12. From what I have seen of these streams I am confident that it will be two or three years before the normal (animal) forms become restored. The downpour of rain was greater than had been known here before in 20 or 30 years, and the beds of the streams were completely scoured of all loose material and now consists simply of round boulder rocks. Millions of forms, both large and small, must have been destroyed at that time. On the 26th of September, while taking a day's leave of absence, I went into the headwaters of one of the largest creeks near here for a day's outing and was completely astonished at the torn up condition of the mountain sides. I had never before witnessed the work of a so-called cloud-burst, but after that day's observation I came to the conclusion that if the Weather Bureau had an adequate conception of the destruction in this vicinity, in that rain, they would probably send a man out here to look over the ground and make a report upon it.

At the point where the cloud-burst occurred the ground was torn up a width of 15 to 30 feet and from 100 to 300 yards in length up and down the mountain side. At the bottom of the mountain slope there were evidences of a violent rush of water, mud, and hundreds of tons of loose rock, stumps, and fallen timber. On Rock Creek, and especially on Martins Creek, the disaster wrought by the storm was phenomenal and something beyond my imagination until I had witnessed it myself. The scars made on the mountain sides can be seen several miles distant.

THE SEISMOGRAPH AT THE OBSERVATORY AT CARSON CITY, NEV.

By C. W. FRIEND, Director of the Observatory.

The seismograph stands on a solid foundation that is about even with the surface of the ground. It is of the pattern known as the duplex-pendulum seismograph. A massive bob is hung by three parallel wires from the top of the three-cornered box, and is reduced to nearly neutral equilibrium by being coupled by a ball-and-tube joint to the bob of an inverted pendulum below it. The two form a system which can be made as nearly astatic as is desirable, and so furnish a suitable steady-point for showing the horizontal component of earthquake movement in any azimuth. The motion is magnified (in the observatory seismograph about four and a half times), and recorded by a vertical lever geared to the upper bob by a ball-and-tube joint, supported on gimbals from a bracket fixed to the box, and furnished with a jointed index, which writes on a fixed plate of smoked glass.

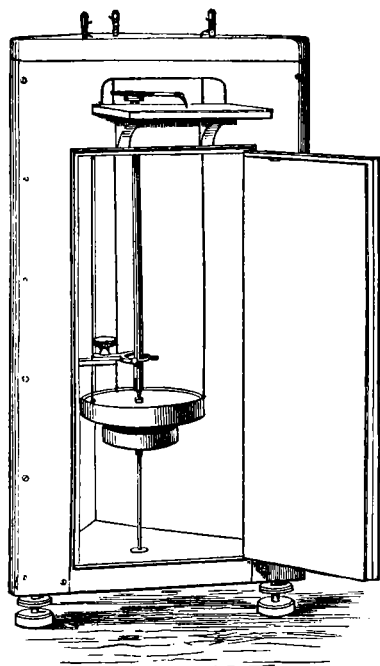


FIG. 1.—Duplex-pendulum seismograph for horizontal motion.

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of Señor Manuel E. Pastrana, Director of the Central Meteorologic-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the Boletín Mensual. An abstract, translated into English measures, is here given, in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means have not been reduced to standard gravity, but this correction will be given at some future date when the pressures are published on our Chart IV.

Mexican data for June, 1900.

Stations.	Altitude.	Mean barometer.	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
Durango (Seminario)	Feet. 6,243	Inch. 24.03	° F. 99.5	° F. 48.2	° F. 74.5	43	0.67	ws.w.	sw.
Leon (Guanajuato)...	5,934	24.27	92.5	56.5	74.5	47	1.51	ne.	ne.
Mexico (Obs. Cent.)...	7,472	23.05	84.2	51.8	66.6	50	1.20	n.	ne.
Morelia (Seminario)...	6,401	23.96	87.4	56.5	71.1	68	5.27	s.	ene.
Puebla (Col. Cat.)...	7,112	23.36	86.5	50.5	69.4	59	4.38	ene.	ne.
Puebla (Col. d. E.)...	2,169	23.33	86.9	51.1	68.4	58	3.78	ene.	ne.
Real del Monte...	9,005	21.63	74.1	39.9	57.0	.....	4.31	n.	.....
Saltillo (Col. S. Juan)	5,399	24.75	91.6	60.6	76.1	53	0.48	n.	w.
San Isidro (Hac. de Guanajuato).....	.....	.....	85.1	69.8	.....	.....	3.76	ne.	.....
San José del Cavo (B. C.).....	.....	.....	90.0	77.0	83.8	.....	.....	s.	n.
Silao.....	6,063	24.22	90.1	62.6	75.4	50	3.28	se.	ese.
Queretaro.....	6,070	24.18	93.2	56.7	72.9	46	1.30	e.	.....

RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined list of titles has been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau:

- Comptes Rendus. Paris. Tome 130.*
 Violle, J. Observations actinométriques pendant l'éclipse du 28 mai, 1900. P. 1658.
La Nature. Paris. 28me Année.
 Plumondon, J. R. La pluie à Nice. P. 75.
Technology Quarterly. Boston. V. 13.
 Rotch, A. L. Use of Kites to obtain Meteorological Observations. P. 89.
Das Wetter. Berlin. 17 Jahrg.
 Muttrich, —. Ueber die Einrichtung von meteorologischen Stationen zur Erforschung der Einwirkung des Waldes auf das Klima. P. 121.
 Pernter, J. M. Wetterschiessen. P. 134.
Scientific American Supplement. New York. Vol. 50.
 McAdie, A. G. Frost Fighting. P. 20512.
Geographical Journal. London. Vol. 16.
 Arctowski, H. Observations on the Aurora Australis. P. 92.
L'Aerophile. Paris. 8me Année.
 Vincent, J. L'emploi des cerfs-volants en météorologie. P. 63.
Philosophical Magazine. London. Vol. 50.
 Wood, R. W. Photography of Sound-Waves, and the Kinematographic Demonstration of the Evolutions of Reflected Wave-Fronts. P. 148.
Gaea. Leipzig. 36 Jahrg.
 Klein, H. J. Wetterprognosen auf mehrere Tage und die täglichen Wetterkarten. P. 475.
Comptes Rendus. Paris. Tome 131.
 Gautier, A. Gaz combustibles de l'air; air des bois; air des hautes montagnes. P. 13.
 Gautier, A. Gaz combustibles de l'air; air de la mer. Existence de l'hydrogène libre dans l'atmosphère terrestre. P. 86.
 Poncare, A. Combinaison des effets des révolutions synodique et tropique; son action sur la marche des dépressions. P. 132.

Popular Science Monthly. New York. Vol. 57.

Wood, R. W. Photography of Sound Waves. P. 354.

Aeronautical Journal. London. Vol. 4.

Wenham, F. H. On Forms of Surfaces impelled through the Air and their Effects in Sustaining Weights. P. 134.

DROUGHTS, FAMINES, AND FORECASTS IN INDIA.¹

By E. DOUGLAS ARCHIBALD.

The famine, which has now for the last two years been devastating India, is a matter of such serious importance in relation to the economy of Indian government and to the rapidly increasing population, that no excuse is needed for discussing in these pages the general causes of Indian famines and their relation to the prevision of Indian weather.

The general causes of Indian famine have been summarized by Mr. Eliot, the head of the Indian Meteorological Service, as follows:

1. Prolonged delay in the commencement of the rains, more especially of the summer monsoon.
2. A prolonged break in the middle of the southwest monsoon rains.
3. Scanty rainfall during the greater part or the whole of the season.
4. Unusually early termination of the southwest monsoon rains.

This last being especially fatal in the case of rice crops on unirrigated land.

In different parts of India these several factors work very differently.

Thus in northern India, which comes under the incidence of both the southwest monsoon or summer rains, and of the comparatively minute but valuable fall in the winter months, famine is usually due either to the failure of two crops in succession, the "Khariff" or summer crop and the "rabi" or winter crop, or to the complete failure of one crop after a succession of poor or bad seasons.

In the Deccan they are usually due to the more or less complete failure of the southwest monsoon rainfall throughout.

In general, it may be said that failure of either the summer or winter rains, or both together, tend to produce famine in proportion to the intensity of the drought, the time of its duration and the area over which it extends. An untimely excess of rainfall seldom produces more than a local scarcity.

One very curious circumstance in regard to the prevalence of famine in India is that the area most subject to famine is not the most arid district, but a zone intermediate between this and the moister areas, which is technically designated as "dry."

Statistically, India may be divided into three areas (1) the arid area with a rainfall less than 15 inches *per annum*. Since all crops grown on this area are watered by irrigation it is practically independent of variation in the seasonal rainfall, and it is a nonfamine area.

2. The dry area, in which the annual rainfall ranges from 15 to 35 inches. This is the real famine area, and on the map appears as two great areas, one in central and southern India embracing the Deccan, Mysore, south Madras, and the other a belt stretching in the form of a boomerang from the Gujrat Peninsula northeastward to Lucknow and Allahabad, and thence northeastward to Peshawar.

In time of severe famines such as the present, when the conditions in both areas are coincidentally prolonged, the famine area embraces both at once and extends more or less symmetrically over the areas adjoining their borders.

3. The moist zone, in which the rainfall ranges from 35 inches to 200 inches and upward. This area, which includes the rest of India, is practically a nonfamine area.

Various attempts have been made to correlate the occurrence of Indian famines with the variations in the energy

derived from the sun corresponding to the periodic changes in the spotted area; but, though there are evidences of parallelism, the relation is not a simple or regular one. The condition of the sun is probably a contributory *vera causa*, but not a *maxima causa*.

Reacting conditions, initially determined by changes in the position of antarctic ice, slight deflections in the equatorial ocean currents and in the vertical and horizontal position of upper atmospheric air streams of abnormal condition, such as those recently shown to exist by means of the kite observations at Blue Hill Observatory, are likely to be far more potent prime causes of seasonal abnormalities than the small and fairly regular changes which appear to follow the appearance and disappearance of sun spots.

In fact, the study of famine prevision can only proceed successfully with that of the general terrestrial factors which lie at the base of the normal and abnormal occurrence of the monsoons.

The comparative regularity with which these periods of similar winds and weather alternate half-yearly is one of the most salient and remarkable features of the Indian weather system, and the study of their proximate and remote causes, their changes from year to year, and their general local distribution of rainfall, have for several years formed the "*maxima questio*" of the Indian forecaster.

For the purpose of prediction, the American or European and the Indian meteorologist regard weather from entirely different points of view.

To the former it appears to be mainly due to the passage of a succession of low and high pressure areas (technically termed cyclones and anticyclones), with their attendant respective characteristics of ephemeral stormy and fair weather.

To the Indian meteorologist, on the other hand, it appears to be chiefly a succession of broad seasonal changes, commencing suddenly in the case of the summer monsoon, and, though characterized by minor changes due to the similar passage of ephemeral moving cyclonic and anticyclonic systems, it remains of a fairly constant and dominant type when once it has fairly set in.

The marked changes from day to day which characterize the proverbially "fickle weather" in England are less marked in that of India, while the persistent seasonal tone of the latter is comparatively unnoticed, even if present in the former.

This apparently radical difference between the weather in India and that of extratropical countries has led to an equally radical departure in the system of forecasting adopted there.

While in England and Europe we are still content with twenty-four hourly predictions, founded chiefly on mere empirical sequences of changes already in existence, and in America the utmost limit at present adopted is forty-eight hours, India has boldly struck out into officially indorsed predictions, issued in May and November, of the average weather of the ensuing half year.

The success of the forecasts which have now been in operation for the last twelve years, has been such that in spite of its well-known financial difficulties, the Indian government has recently extended its field of observation so as to embrace portions of Persia, Kashmir, Arabia, east Africa, Mauritius, and communication with west Australia, and with good reason, for as the investigation of the conditions upon which the initiation and persistence of the monsoons depend proceeded, it was found that the local factors, such as early hot weather in the plains, or late snowfalls on the Himalaya, were insufficient to account for the large anomalies presented in different years, and that extraneous causes were at work in surrounding areas which dominated and often masked any apparent temporal coincidences such as were too readily accepted in the early period of Indian meteorology as sufficient to account for everything.

¹ Reprinted from Symons's Monthly Meteorological Magazine for June and July, 1900.